



NOAA Remotely Operated Aircraft Activities

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Purpose



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- Information Briefing



Outline



- ROA Overview
- NOAA ROA Demonstration Project
- Recommendations



Why ROAs

- **What is a ROA?**
ROA, or Remotely Operated Aircraft, is an acronym that is used to reference any unmanned aircraft regardless of its mode of operations (i.e., autonomous, pilot-in-the-loop, etc). The term ROA is synonymous with Unmanned Aerial Vehicle (UAV), Uninhabited Aircraft and other terms.
- **Best choice to perform dull, dirty, dangerous tasks:**
 - **Dirty**: ROAs can be sent to contaminated areas
 - **Dull**: Long transit times acceptable-Large ROAs provide endurance 24 - 72 hours, allowing for new dimensions of persistent surveillance, tracking, and data collection
 - **Dangerous**: No risk of human life, possibly expendable
- **Requirements for civil applications are emerging for ROAs in the US**
- **Market pressures provide increased innovation and manufacturing in US aviation industry**



Where are ROAs now?



- Military is primary user; DHS requirements are rapidly developing; civil use to follow
- DOD ROA Roadmap
- Access 5 Program
- UAV National Task Force (UNITE)
- RTCA Special Committee 203

Types of ROAs

- Endurance - operate at higher altitudes and longer ranges
- Tactical –operate at lower altitudes and within line-of-sight
- Small –man-portable and to operate within a few miles of the control station
- Micro – are hand or smaller sized ROAs (six inches maximum)

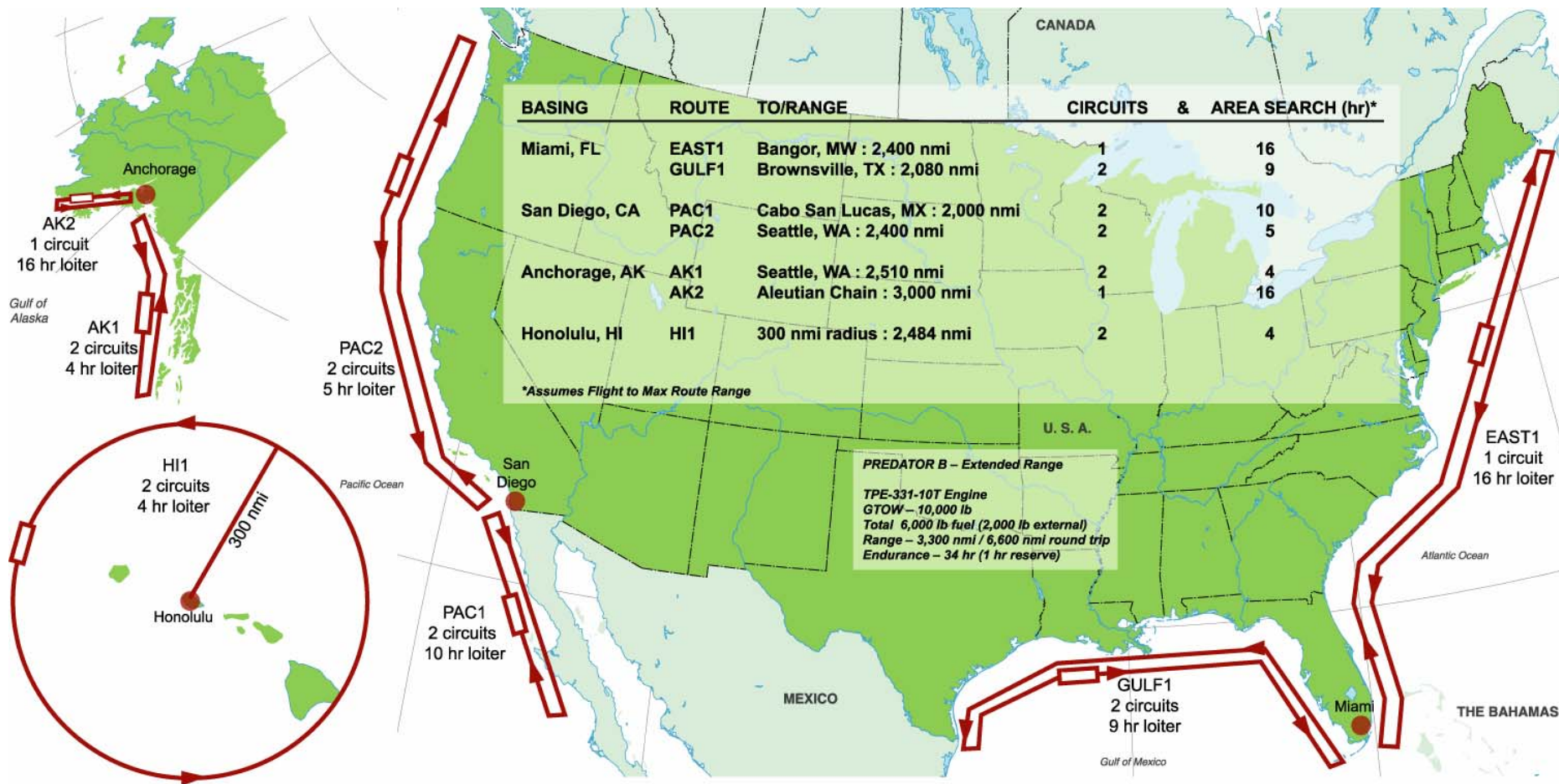


ROA Range Possibilities





Persistent Presence Possibilities Provided by ROAs



Note: Flight Routes ≈ 300 nmi offshore



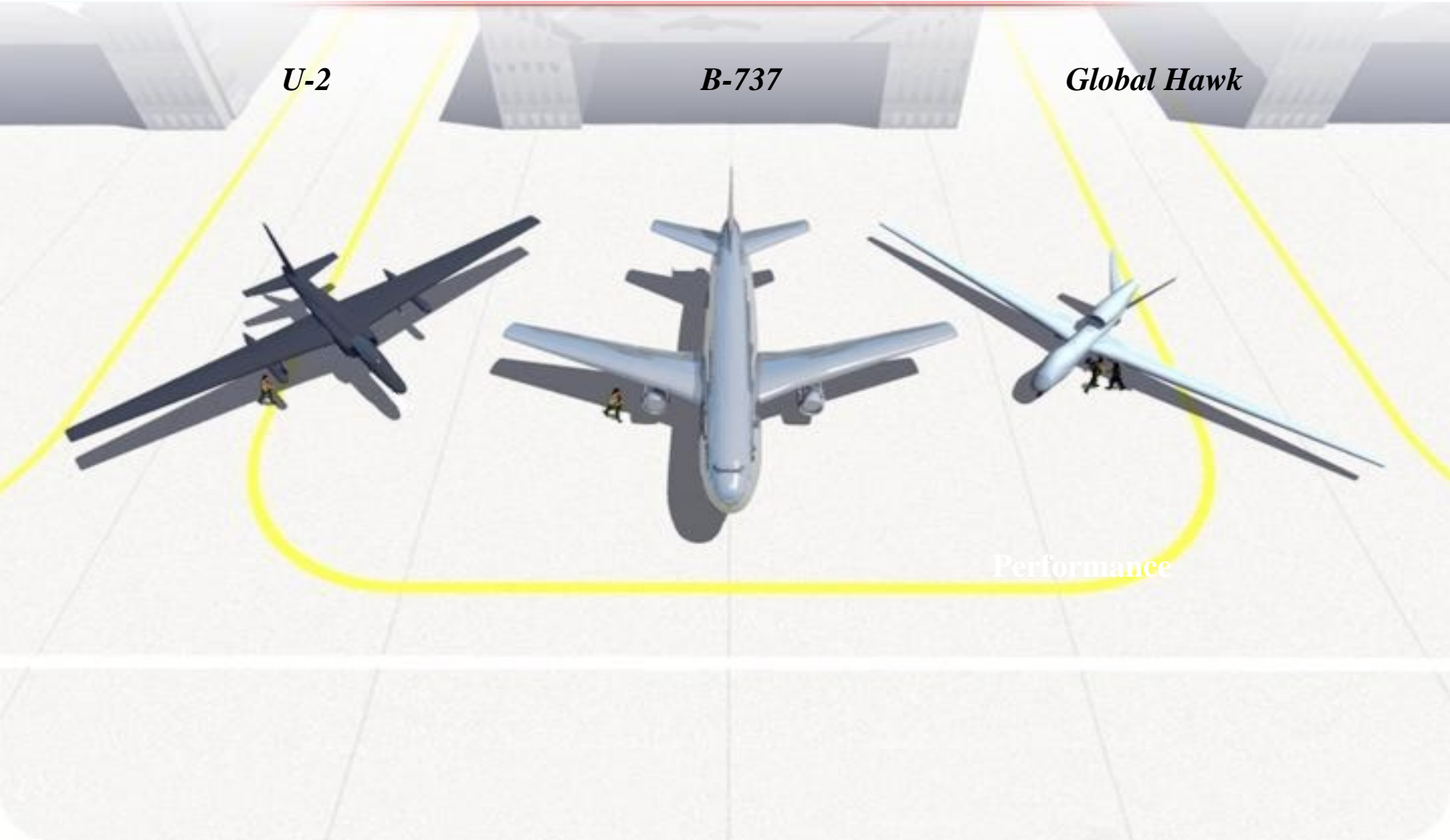
Global Hawk Size Comparison



U-2

B-737

Global Hawk



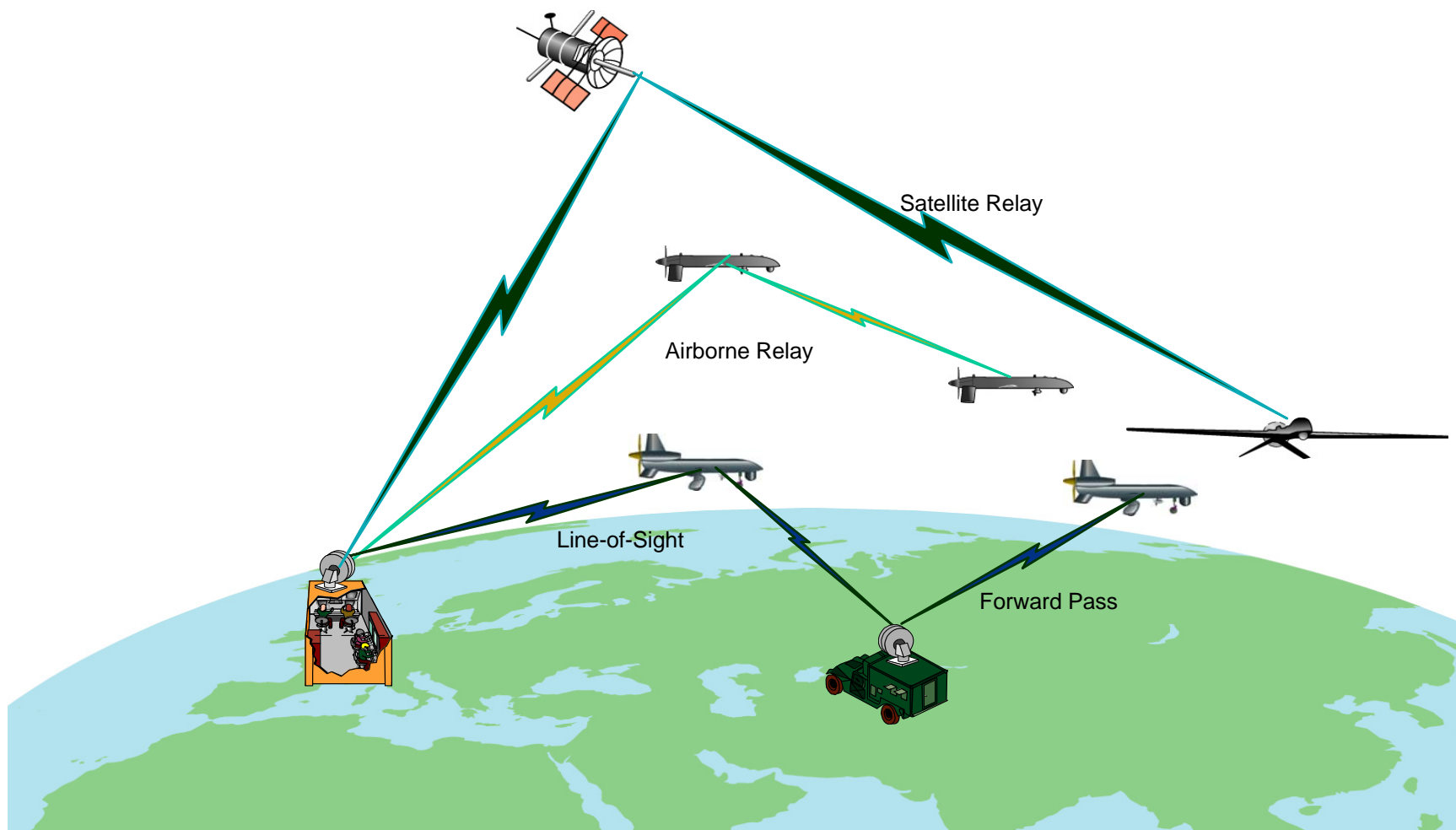
Performance



Ground Infrastructure for ROA



ROA Data Link Options





Where ROAs Can Possibly Support NOAA Requirements



- **Global Observing and Atmospheric Research:** ROAs can provide detailed vertical profiles of the atmosphere and ocean at a large number of fixed points over the globe.
- **Fisheries Enforcement:** NOAA fisheries enforcement encompasses the entire 3.4 million square miles of the Exclusive Economic Zone.
- **Hurricane Tracking & Research:** G-IV is limited to around 45,000'. A ROA capable of 60-80,000' would give this capability for dropsonde delivery to over almost all hurricanes, stay on station longer, and not risk an aircrew.



Where ROA's Can Possibly Support NOAA Requirements



- **Charting and Mapping**: Charting the near-shore of the 3.4 million square miles and remote areas (NWHI).
- **Ecosystem/Habitat/Marine Mammal Support**:
 - Coral Reef mapping: The ability to support spectrally robust sensors in remote areas for sustained periods.
 - Marine Mammal mapping: A non-obtrusive instrument for identifying, tracking, and sighting of marine mammals.
 - National Marine Sanctuaries: ROAs may have numerous applications for conservation science and enforcement especially in remote areas.



NOAA participation in the USAF Weather Scout UAV (WSUAV) Demonstration



- Requirement to improve and extend forecasts, improve situational awareness
- Utilize a weather reconnaissance UAV to improve data collection—WSUAV CONOPS
- Aerosonde UAV will potentially meet WSUAV requirements
- Cost: \$1.55M for 1500 flight hours
- NOAA providing model improvement analysis, flight planning assistance, and observers (NWS/NCEP, OAR/AOML, NMAO)



USAF Weather Scout UAV

Demonstration

Aerosonde



COTS – UAV and weather sensors

- Range: ~1800nm
- Altitude: up to 20k ft
- 30+ hours flight time
- GPS Navigation
- Communications
 - UHF Radio, LEO Satellite
- Pressure, Temp, RH
- Wind dir/speed



Wingspan ~10 ft

Weight 29-33lbs

Engine 24cc Fuel-injected



Challenges



- ROAs will need airspace access comparable to manned aircraft
- Very low altitude small ROAs pose real challenges to the FAA and manned operations
- National and International issues of frequency spectrum, standardization and airspace interoperability need to be addressed
- Major technical issues are communications and detect-see-avoid capability
- ROAs are weather limited

NOAA Remotely Operated Aircraft Flight Demonstration Spring 2005



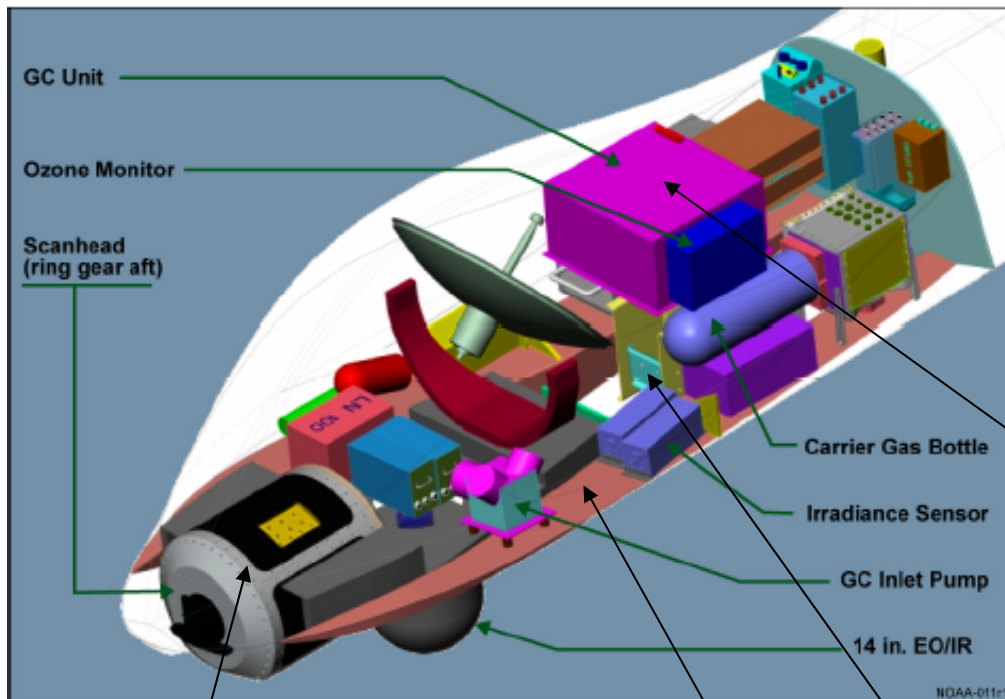
- The ALTAIR, a high altitude version of the Predator B, was specifically designed as an unmanned platform for both scientific and commercial research missions.
- Built in partnership with NASA, the ALTAIR has an 86 ft wingspan, can fly up to 52,000 ft and can remain airborne for well over 30 hours.
- Marked as the first remotely piloted aircraft that will meet aviation authority requirements for unmanned flights in National Air Space.



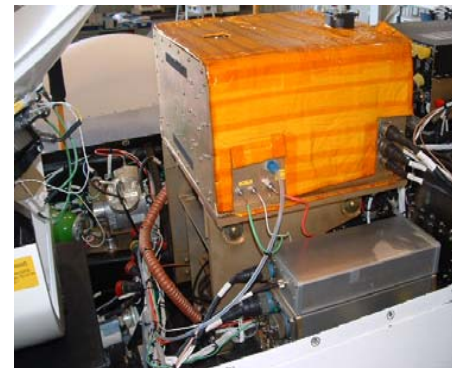
NOAA Investigates the Utility of ROAs for Atmospheric and Oceanic Research and Science Operations



- NOAA determines objectives, defines requirements sets priorities, establishes success criteria, participates in the demonstration, and evaluates results.
- GA-ASI provides the aircraft, ground systems, performs all operations and maintenance and manages the Demonstration for NOAA.
- GA-ASI leverages significant experience in similar ROA scientific operations for U.S. and foreign governments.
- NASA contributes significant ROA experience to assist NOAA in planning and conducting the Demonstration, sponsors the Certificate of Authorization, and provides safety and operations oversight.
- NOAA, NASA and GA-ASI Team cooperate on planning, execution and share lessons learned.



Combined ozone photometer and gas chromatograph instrument



Direct Geo-referenced Digital Camera



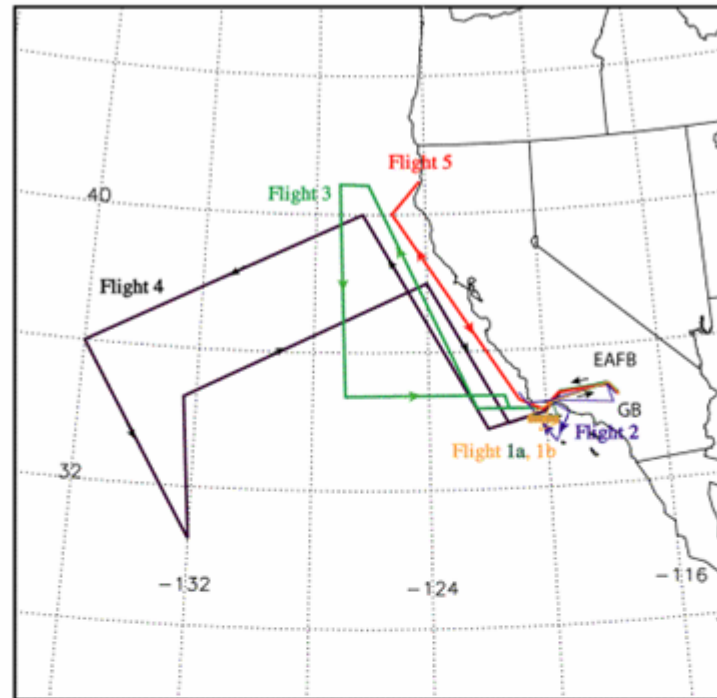
Ocean Color and Passive Microwave Vertical Sounder



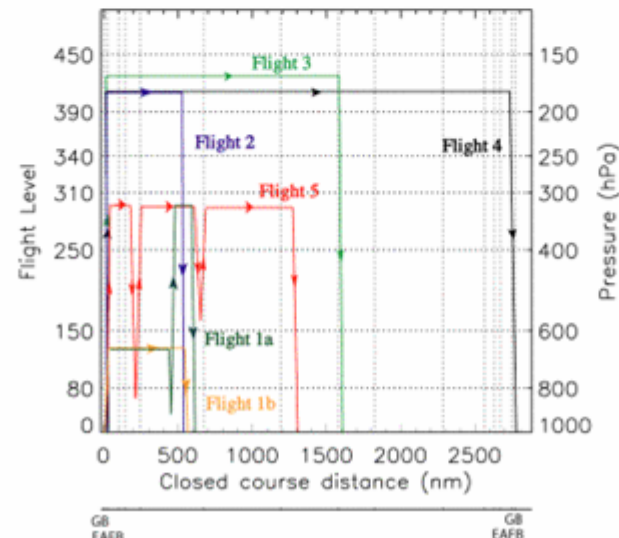
Composite Flight Mission Description

- Flight 1a: CI Survey/Ocean Color 6 hrs**
Goals: Evaluate platforms capability to perform remote sensing missions. Evaluate the utility of ROAs as platforms for marine enforcement surveillance. Perform OC sensor calibration profile.
- Flight 1b: CI Survey/Day-Night 4 hrs**
Goals: Record fishing and boat activity during daylight and nighttime hours. Identify and record general vessel activity within CINMS and evaluate the EO/IR's ability to identify fishing activity and marine mammals.
- Flight 2: Sounding Curtain/Atmospheric Chemistry 6 hrs**
Goals: Retrieve vertical profiles of temperature and water vapor between radiosonde launch locations. Sample the tropopause region.
- Flight 3: Cross-Tropopause Sampling 12.5 hrs**
Goals: Use the GC/OZ instrument to sample polar air masses and to demonstrate the potential of validating Aura satellite retrievals and estimating the age of air in the lowermost stratosphere.
- Flight 4: Atmospheric Rivers Sampling 21 hrs**
Goals: Profile along and across an atmospheric river approaching the California coast. Sample tropopause region.
- Flight 5: Ocean Color Profile/Trinidad Head Profile 21 hrs**
Goals: Perform vertical profiles over blue ocean and near Trinidad Head Observatory.

Altair Flight Tracks



Altair Flight Profiles



Composite flight tracks and flight profiles



Demonstration Project Costs

Integration Costs

NASA Integration Costs	\$149,618
NOAA Integration Costs	\$591,588

Flight Test & Mission Support

Pre mission activities	\$80,625
Mission Flights (53 hours)	\$243,507
Insurance (SATCOM,EOIR)	\$55,228
30 day SATCOM Fee	\$155,086
SATCOM Equip Fee (Lease)	\$178,018
Chase Plane Lease	\$31,635

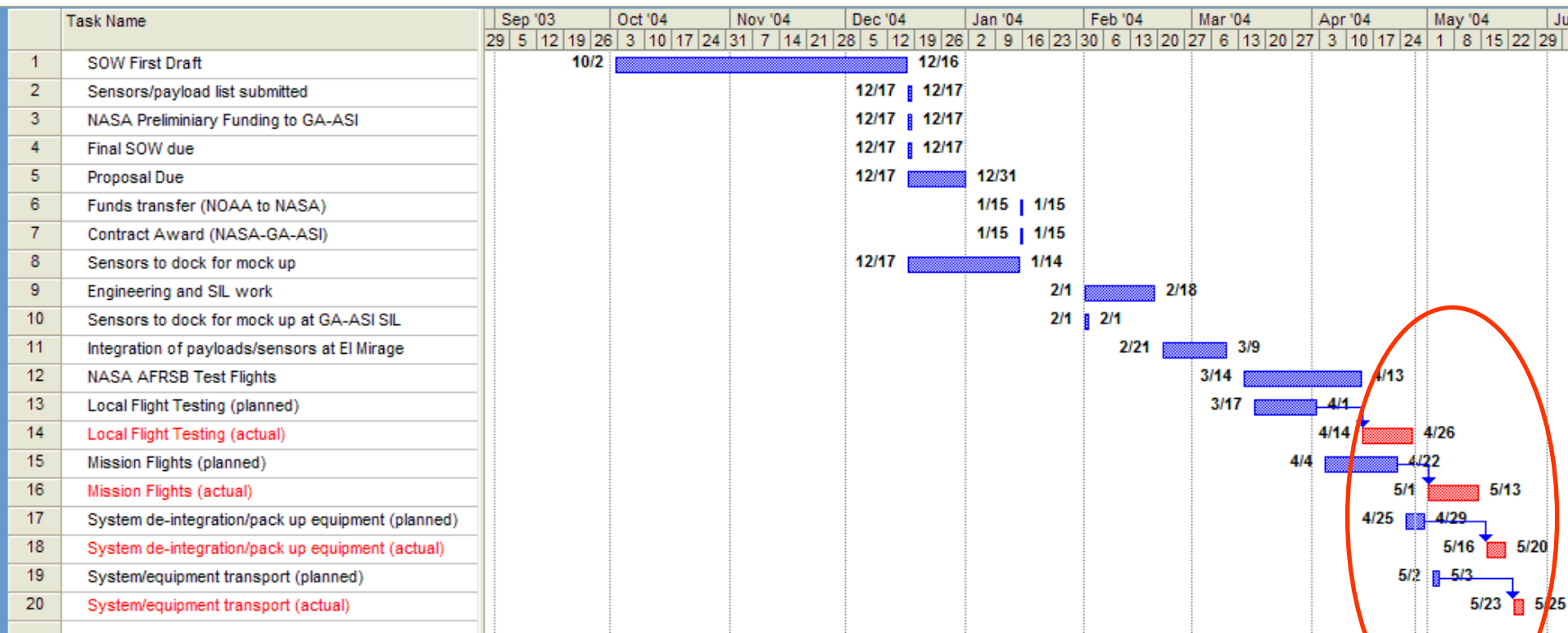
NASA Overheads	<u>\$133,530</u>
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<u>TOTAL</u>	\$1,618,335
Less NASA Integration Costs	\$1,469,217

Funding Source: \$1300K from ADF with funding and in-kind contributions from across NOAA



Schedule



Schedule slip (23 days) due to:

1. Procedure change by FAA for COA
2. Additional flights for NASA safety review
3. Hardware malfunction at ground station



Lessons Learned



- **Start flight approval processes early**
 - FAA Certification of Authorization (COA) for access to the National Airspace System (NAS) – still dynamic
- **Leverage other agencies experience, missions, and requirements**
 - NASA
 - COA process
 - Aeronautics mission
 - Safety reviews
 - DOD
 - Operational experience
 - Training, documentation, procurement programs
 - Predator family most widely used endurance ROA over 100 in service with over 120,000 flight hours
 - USCG/DOE
 - Common requirements and area of interests



Lessons Learned cont.



- **Sensor design and integration**
 - One time investment per platform and very costly relative to entire cost of the demonstration (45% - \$742K - of cost for this demo).
 - Sensors should be of mature/validated design with proven autonomous/remote operation and tested extensively.
 - Real time downlink requirements should be evaluated carefully.
 - Integration into ROAs are more flexible, faster, and cheaper (ex. hull penetrations, custom housings, external pods).



Lessons Learned cont.



- **Operations**

- Flight conditions such as weather are a factor in the ability to fly ROAs on any given day (wind, icing)
- Software dependent flight Command and Control System
- Ku band over the horizon satellite critical infrastructure requirement
- Frequency coordination/deconflicting an issue
- Real time interaction between the pilot and PI is easier and more productive
- Successfully demonstrated real time data delivery and sensor monitoring over the internet
- Platform truly capable of multi-mission role with respect to operating altitudes, speed, and endurance
- The importance and capability of endurance alone cannot be emphasized enough – no manned platform capable



Recommendations for NOAA



- Develop a NOAA ROA Working Group and Steering Committee
- Appoint a single point of contact for ROA Activities across NOAA
- Use GA-ASI ALTAIR for additional demonstrations
- Require all NOAA ROA activities be executed through NASA with NASA co-sponsored COAs
- Pursue partnerships with other Federal Agencies with common interests and requirements
- Participate in ROA airspace integration activities



Questions?

<http://uav.noaa.gov>

